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ABSTRACT

This paper is part of a series of studies about the nature of expertise in teaching and the cognitions of effective teachers. A summary offered of psychological research on the nature of expertise indicates that experts often know more, in a more elaborate way, about the subject than novices and organize knowledge in a different fashion. It is also noted that tasks presented elicit different levels of schema--that is, the same elements in a task may be identified by both experts and novices, but key elements trigger deeper, and more elaborate schema for experts than for novices. A description is given of an evaluation study in which novices (observers with two years of classroom experience) and experts (teachers) estimated the overlap between the curriculum to which a child had been exposed and a criterion test for each child. Four of the teachers and three of the observers were further asked to provide a discussion of their thoughts while doing the overlap task. The quantitative findings are reviewed, and the qualitative findings are discussed in detail. Also included are quotations of subjects' thoughts, as the subjects formed conclusions on and predicted the potential abilities and expected achievement of the children. Directions for the overlap test are appended as well as diagrams illustrating the subjects' thought processes. (JD)

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Novice and Expert Knowledge of Individual Student's Achievement

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Novice and Expert Knowledge

of Individual Student's Achievement

This paper is part of a series of studies into the nature of expertise in teaching, more specifically teaching of the primary subjects (reading and mathematics) in elementary schools. The research builds on the psychological studies of expertise in areas such as physics, radiology, spatial mapping, social science and chess (Chi & Glaser, 1982; Chi, Glaser & Rees, 1982; Larkin, McDermott, Simon & Simon, 1979; Lesgold, in press; Simon & Chase, 1973). The research reported here contributes to the work on expertise by altering the setting from constrained abstracted formalized tasks to a setting which is natural, unstructured, and potentially dynamic. The research also builds on the educational studies of teacher planning and decision making among reading, social studies, writing, and homeroom teachers (Borko & Niles, 1983; Jackson, 1966; Peterson, Marx & Clark, 1978; Shavelson & Stern, 1981; Yinger, 1977), often referred to as the study of teachers' cognitions in order to distinguish it from research on instructional practices or process-product research.

The work on the cognitions of effective teachers is an outgrowth of research on effective instructional practices, which has supported a basic model of elements that influence student academic growth. To review briefly, the post-test achievement of a group of students is a consequence of initial ability and attitude, student learning behaviors and teaching behaviors (See Figure I). Student learning behaviors are influenced, in turn, by the student's thought processes, by aspects of instructional

pacing and management, and by the background characteristics of the student (Leinhardt, Zigmond & Cooley, 1981). Teachers' classroom behaviors are influenced by knowledge of the curriculum and subject matter, by pedagogical theory, by the agenda that is operating not only for that day but also that week and that particular block of time, and by knowledge of students. It is this latter aspect of knowing students that we are addressing here.

Insert Figure 1 Here

Within the domain of teacher cognitions considerable research has gone into the description of teacher plans (Jackson, 1966; Peterson, Marx & Clark, 1978; Yinger, 1977), and the relationship of those plans to actions. There has also been some important work that focuses on the relationships between thoughts and actions (Anderson-Levitt, 1981; Clark & Peterson, 1981; Doyle, 1977; Janesick, 1978; McNair, 1978-79; Morine, 1976; Morine & Vallance, 1975; Shavelson, 1981). Recently, Morine-Dershimer (1982) has expanded the focus to include examination of the socio-linguistic aspects of teaching.

Psychological research on the nature of expertise has been well summarized in two recent papers, Lesgold (in press) & Chi, Glaser & Rees (1982). To recapitulate their summaries, experts differ from novices in the following ways: First, experts often know more in a more elaborate way about the subject than novices, but more important, they organize that knowledge in a different fashion. Tasks presented elicit different levels

of schema - that is, the same elements in a task (key words or phrases) may be identified by both experts and novices but those keys trigger deeper, more elaborate schema for experts than novices. Novices may have the declarative knowledge needed to solve a problem but do not access it. An expert spends time conceptualizing the task and finding a qualitative representation. A novice spends less proportional time conceptualizing the problem and is more likely to attend to the surface features of the task.

In considering the nature of expertise in teaching we start by examining the total teaching context and then focus on a single aspect. Teachers' cognitions are strongly influenced by something we refer to as the agenda for the current operating time block, whether that agenda encompassed the month or day or just that class period. An agenda includes planning, but lesson plans are only a fragment of the total cognitive plan that the teacher brings to the lesson presentation. We conceptualize teachers as operating with predefined agendas that are modified by issues of time and student response. An agenda is a dynamic plan that operates like those described by Hayes-Roth & Hayes-Roth (1978) and Sacerdoti (1977). The agenda is constantly being revised and updated by the teachers' subject matter knowledge, by his/her knowledge about students, by knowledge about time, and indirectly by curriculum knowledge. A summary of that conceptualization is presented in Figure 2.

Insert Figure 2 Here

Figure 2 shows teacher behaviors as a consequence of teacher cognitions. Teacher cognitions are in turn influenced by the following: social cues from students; verbal cues from students; the teacher's knowledge of the curriculum and subject matter; the agenda in use; time; and the teacher's knowledge of students (cognitively and affectively). The agenda is in turn affected by curriculum knowledge, time constraints, and student knowledge.

The current study is about midway along a theoretical continuum, of distance from a natural teaching act to an artificial laboratory task. It focuses on a known element of importance in a restricted situation, namely teacher knowledge of students' potential for academic success.

Knowledge of students encompasses several categories of information. It includes information about the student's home life, siblings, attitudes towards school, subjects, peers, etc. Some of our recent evidence suggests that teachers are acutely aware of such factors. It also includes information about the academic experiences and competencies of students. Previous work indicated that teachers were quite remarkable in their ability to assess what students know and don't know. (Leinhardt & Seewald, 1981). Specifically, teachers could estimate the fit between what had been taught and what would be tested quite accurately. Further, the estimate of that fit is a significant predictor of student criterion performance (Cooley & Leinhardt, 1980; Leinhardt & Seewald, 1981). The knowledge that teachers' views of student competency were of substantive interest in and of themselves and that a quantitative estimate of competency had predictive power in estimating achievement attracted us to this aspect of teacher cognitions.

The Subjects

As part of a larger evaluation study (Leinhardt, Zigmond & Cooley, 1981), we have studied reading instruction in classrooms for the learning disabled. We observed in these classrooms for approximately two years. Observers collected extensive data on student academic progress and were thoroughly familiar with the curricula used to teach reading. The observation system required close and careful analysis of the specific reading actions the students engaged in. There was moderate student turn over (55 students out of 105 were in both years of the study) and there were approximately 12 students in each class- sometimes less, never more. Novices consisted of eleven observers who had twenty hours of observation the first year, and thirty hours of observation in the second year. Experts consisted of the teachers in the classrooms under study. We asked all eleven (experts) teachers and all eleven observers (novices) to estimate the overlap between the curriculum to which a child had been exposed and a criterion test for each child.

In addition, four of the teachers and three of the observers were further asked to provide us with discussions of their thoughts while doing the overlap task. The four teachers had considerable experience teaching and were the best of the teachers. Expertise, for these four teachers, is defined in part by the growth of the students and in part by skill in bringing students into contact with appropriate subject matter (high levels of academic engaged time.) The 3 novices were chosen from among the observer team: One was an experienced LD teacher; one was a former teacher, and one had no teaching experience (2 were female; one was male). The novices had been richly exposed to the reading behaviors of

the students but had a much lower density of exposure, and less reason to consider themselves knowledgeable about the student than teachers, that is, they had not been addressing salient instructional questions while observing.

The Task and Methods

As one measure of assessing teachers' knowledge of students, we obtained protocols of their thoughts about students and instruction as they were performing the overlap task. The overlap task involves giving a teacher a copy of a standardized achievement test (the day of the administration or shortly thereafter) and asking the teacher to go through it and report whether a child has had sufficient instruction to get each item correct or not. For this study only the reading subtest was used. We did not ask whether or not the teacher thought the child could get it right, although many of the teachers and observers commented on this; rather, we emphasized whether the instruction covered had been sufficient for that particular child. Essentially we were asking the teachers and observers to recall instruction and to speculate on its relevance for criterion tasks. This requires the respondents to analyze the criterion task into teachable subcomponents and search the known instructional space for a match. The organization of the instructional space is in and of itself of considerable interest. In this study each subject estimated the level of overlap between test and instruction for each child in the class (usually 12 students). For 2 of the children we asked the subjects to think aloud on 20 items, reporting whether or not the child had sufficient information to pass that item, and to give their rationale for their decision. The Appendix displays the items about which they were specifically asked to think aloud as well as a copy of the initial

instructions. In sum, each teacher and novice was given a copy of the test and each child's name and was asked to fill out all of the items for all of the children in the class. For particular children and particular items, the teacher was asked to think aloud.

The overlap task taps an important skill for teaching, knowledge of student competency. Teachers who have a good sense of this are in a position to teach more effectively, to target instruction to students, and to assign tasks at a more appropriate level for students. While we do not know whether an individual teacher makes use of the information about student competency, it is clear that the teacher can not use it if s/he does not have it. In addition to tapping an important teaching skill, the overlap task is interesting in another way. In order to answer the overlap questions the teacher must call on three relatively distinct bodies of information: student skill, item requirements or analysis, and curriculum sequence. The teacher can go in either direction, calling up information about the students or about the curriculum and then analyzing the problem.

Overlap scores were obtained by taking the total number of items estimated to have been covered, dividing by the number of items on the test and multiplying by 100. The percentage of hits was obtained by scoring each item as an agree/disagree between specific estimates and student performance. The agrees were then divided by the totals (agree + disagree) and multiplied by 100. Protocols were transcribed and analyzed with respect to several themes: overall model of explanation, classes of reasons used, unit of material referred to, sources of instruction, student strategy, higher order reason for outcome prediction, and teacher explanation of knowledge source. Overall model of explanation refers to

the general scheme that seemed to be used when explaining student performance. Classes of reasons refers to the type of explanation. Unit of material refers to the level at which analysis was provided by the teacher (phoneme clusters, word, phrase, meaning, etc.). Source of instruction refers to where or when in texts or instruction the material was covered. Student strategy refers to the way teachers or observers expected students to approach the task. Higher order reason refers to a more overriding or global explanation for expected outcomes. Finally, teacher strategy refers to the general approach teachers or observers use to answer the questions.

Findings

The quantitative findings will be reviewed and then the qualitative findings will be discussed. The means and standard deviations in hits, overlap, and actual percentage correct is presented in Table 1, along with the correlations.

Insert Table 1 Here

Table 1 indicates that the overlap estimates of experts and novices and the actual performances are quite closely clustered. Both teachers and observers estimate a slightly higher overlap between instruction and performance than appears in actual performance. The accuracy of the experts and novices, as revealed by the hit scores are likewise quite close, with novices being less than one-half a standard deviation lower in

accuracy. Given the detailed level of exposure to both students and curriculum, this finding is not surprising.

The results show a very modest correlation between expert and novice overlap scores and hits. They also show an interesting pattern in that teachers' overlap estimates and hits are related to actual performance more closely than novices'. Thus, teachers estimate overlap more accurately and their hit rate is better for high achievers (Perhaps older children who may have been with them longer). Novices' total overlap estimate is not so close and their hits, which are quite close in numbers to the teachers', are distributed across high and low achievers more evenly.

Insert Table 2 Here

Table 2 shows the average number of lines of protocol for novices and experts for each of the three subtests of the CTBS level C. For all 3 subtests the teachers have more lines of protocol than the novices. Thus they talk more about the children and tests than the observers, but the real question, of course, is do they say more? The qualitative analysis that follows addresses that question.

Vocabulary Subtest

For the first subtest of the reading test, vocabulary, a word list is given to the students and a definition is read orally; the student must select the correct word. In order to do this, the student must listen to the definition, remember it, search the word list for the one that fits; or think of an answer and try to match their own answer to the word list. Teachers and observers tended to focus on the correct answer and then describe the probability of a student knowing or deciphering it. Several features of the protocols are useful to examine in order to understand differences and similarities between observers and teachers.

Unit. The first of the feature is the unit used in describing the student's exposure to the material in the item. Two of the novices focused exclusively on the entire word. For example, (Wet) "I think Cherie can read sight words very well," or (bake) "I think she can recognize 'bake'", or (heavy) "I think she's been taught size words". A second novice said about the word bake, "Well, first thing it would be easier for her than a boy because you know, they've made a cake with their mother,...it's a simple word really." or for another child, "I don't think he's interested in making a cake".

In sharp contrast, teachers focused on the elements of the word that made them decodeable, and in general, assumed comprehension. For example, for wet, "I think he would be familiar with the word wet in particular, because of the Glass analysis, the et cluster", or (bake) "We talked about silent e mostly from Ginn materials. We didn't do the ake cluster in Glass. That's in Ginn, long vowels silent e, we did that". One of the

observers, looking more like the teachers, tended to focus on more of the decodeable elements of the target words. However, the novices' comments were much more fragmented and just dealt with the element or followed a prompt for more information. Of the seven items in the subtest, each of the novices gave word level analyses in 71 percent of the cases, while teachers gave vowels, vowel consonant clusters, rhyme patterns for 66 percent of the cases. Teachers focused on elements of the task that were teachable; observers on more general knowledge. It is important to note that given the extended observational time, observers had ample exposure to the details of the curriculum material.

Source. An even more noticeable different between the two groups appears in their references to different sources from which the child could gain the information. Teachers cite: phonics work books, flash card drill, spelling, math lessons, text levels, Glass or word family drills, and rhyming games. Novices rarely identify any source at all. When they do, it's with phrases like, "basals spend time on that." This reflects differences in information level and also differences in the way the two groups saw the task. Teachers focused on teachable elements and on sources of that instruction almost as if an underlying question was, "If you were to teach a student this material, how would you do it?" Or, "With what materials?"

Strategy. We also examined the protocols to see if one or another student strategy was suggested more commonly. Teachers expected students to use the same strategy that they had been taught: namely to sound out the word, recognize it and work it back to meaning. One observer described sounding out strategies in some detail, but the other two focused on word meaning and global item characteristics. Novices tended not to describe how a child might get the item correct and tended not to describe the elements required to get it correct. Thus, novices did not generate the information spontaneously and, in the absence of probing for it, we do not know if they had a concept of student strategy or not.

Prediction. For some items a higher order reason for a prediction, that is, some information that went beyond item features and focussed on specific knowledge about the child or situation was given. Again, teachers, when they used these, tended to be more specific than observers. Consider, for example, the teacher (gallop) "That's two syllables. He'll get mixed up when he sees 'a-l-l' and he'll call it 'awl'. Every time he sees a-l-l he calls it awl. He can't say al [as in pal] when he sees that. And just him seeing the two syllables, that'll throw him." The teacher combines an in-depth discussion of the phonics with an aside about the child. As opposed to the observer saying, (awful) "...Now I'm not sure she knows what "terrible" means and awful. She'd probably associate those. I don't think it would be from what she'd been taught in the class, but just from the way kids around...you know..." This points up a difference in specificity as well. Both teachers and observers made gratuitous comments about the level of child they were talking about: teachers as an excuse for why a student would miss an item

taught after a discussion of some detail; observers as an explanation of basic performance.

Reading Sentences

The second section of the test dealt with reading sentences and was labeled a comprehension section. To answer this portion of the test, the child has to read a sentence with a list of words embedded in it and select a suitable word to insert from the list of alternates. (See Appendix) So a child must decode the sentence, hold in memory the segments of the sentence that are given, then decode lists of words, trying each in the place, or on reading the sentence, generate the correct word and search for it.

Teachers approached this portion of the test as a logical extension of the previous section. They did not mention the switch in modality from listening and reading to all reading. They focused on elements below the word level used to analyze the correct word, but made more frequent reference to total words than in the vocabulary section. Observers clung even closer to the word level analysis than before. As with the vocabulary section, teachers referred to the source of key words continuously - where the sound or total word was taught. "Okay. Number 6. The word is visit, and he could have gotten a clue for sounding out this word because it contains two small words, is and it, [strategy]. And all these words, well, he's seen them everywhere in all facets of his work. He should have been able to sound out the words using the NRS method and I think this word has been presented, not in spelling, possibly in phonics, but I'm sure the word has been used as a vocabulary word on the board, and blending, and us writing sentences together in class."

Observers rarely referred to instructional sources and when they did, it was only to the main text.

Of more interest was the experts' expansion out from key words to stem words and their recognition that more than the key word was needed, but not all the words were needed. For example (o'clock), "Okay. I'm thinking, It is nine fine. in the ... if he doesn't know morning you know, it is nine what? He won't know hour probably. Time he should know. Children he should know. If he knew morning -- it's sort of you can get it from the context. So...I'm thinking morning more than I am o'clock because I think he should be familiar with it."

Another expert focused more on key words and on the distraction. For example, (visit), "I don't think she's had the v sound. Yes she has. She had it in Book 5. Okay, there's a chance she might get that. She's been exposed to it, so I'll check that she's had it. We've done a lot of rhyming with sit,... But I still think like Tom she'll go for care, they recognize care and they'll just snap choose it." Teachers were sensitive to both the clues and confusion posed by the more complex format. They pointed out words that were not necessary to know but whose resistance to simple decoding would confuse the student.

The novices showed differing patterns. One examined the total task and focussed on a few words, the key plus a couple of others, and assessed the difficulty level in terms of decoding. For example, (music) "No. I don't think that she'd be able to get very much of this item because of the word listen, there's a silent t. 'Loud' is an o-u that comes together, I don't think that she's had any rules for putting those things together. And 'music' is a two-syllable word with a funny...well it's not

actually funny ... u sound." This was the same person who did a more fine grained analysis in the vocabulary subtest. The other two novices stayed at a more global level. One, the former LD teacher, showed very little understanding of the task demands and gave short abbreviated responses, "`people clap when they enjoy a show` - I would say she would know that from experience." Or from the other novice, "She understands what 'clap' means, and that you do it at the end of something." This novice also had a strong sense that the basic strategy used by students after word decoding would be elimination of incorrect responses. Although elimination was mentioned once or twice by teachers and seems a logical test taking strategy - if decoding and trying alternatives is not hard, it wasn't a favored approach. Observers seemed to examine the test as if they were taking it and the reading was a little hard (maybe as with the early stages of foreign language study). They attribute rather sophisticated test taking skills to rather weak readers.

The reading comprehension subtest is seen by both observers and teachers as requiring a little something more in the way of skill than the vocabulary subtest but not as a totally different task or a major expansion. Teachers seem to retain a stronger sense of the reading nature of the task while two of the observers at least focus in the understanding - with reading assumed - nature of the task.

Reading Comprehension Passages

The last section of the test includes several passages, each of which is a couple of paragraphs long. For each passage there are two to four questions that relate to the passage. The two samples chosen for protocols include a story about a horse named Silver, followed by four questions, and a short paragraph about spacemen in a rocket going to the moon, followed by three questions. The questions include information directly embedded in the passage and so called inference questions. These questions require the child to read and understand a question, remember it, and search the paragraph for the one or two sentences that have the information or to read and remember the basic paragraph, then read the questions and recognize or search the paragraph for the correct response.

The most striking thing about the protocols is that in four of the eight cases, teachers thought a child would not be able to answer any of the questions or would only get one right; one observer also felt a child would miss all the items. Thus, at least at some level, this subtest is seen as much harder than the other two.

The teachers and observers also shift unit of focus and attribute success or failure to words, phrases or whole questions, with very little mention of components of decoding. Interestingly, the mention of sources drops considerably. When sources are identified, it usually is in reference to the class work but not curriculum material. In one case the teacher says, "He is in the beginning of Level 5 in Ginn, and up to this point they have not been given very many, I mean, the comprehension is not involved at this point..." as an explanation that the child will be unable to do the entire subtest.

When teachers identified a strategy that a student is likely to use, they refer to key words or searching text. For example, "Students themselves have taught each other that [To search from question to key words in a passage]. I didn't realize they were doing that until Robin one day confessed to me that she didn't read her story, and she said, `Well you know, Cheryl taught me or told me the way to do it...is to read the question and you look up and can find the answer very easily!`" Clearly, this successful test taking behavior is not viewed as an appropriate in-class behavior. However, several teachers and observers expected children who could not read and understand the passages to try this approach.

In describing the reasons for their predictions, both teachers and observers often referred to basic personality as reasons for responses. A teacher says, in reference to choosing the best last sentence, "He cannot make final judgements, even though we worked on a little bit of this with him...He would just never be able to choose an ending." Or, "I think she should...she has enough information to do that, if she doesn't panic by the number of sentences that she sees. Paragraphs seem to frighten her...She's been exposed to it minimally." Or, "but this would be overwhelming for Tom. By the time he would finish sounding out maybe the first sentence, it just would be impossible for him to retain all of that to come back and answer questions. These three responses also point up the ambivalence frequently expressed: I taught it but s/he doesn't know it. Statements of this type made by teachers tend to focus on items that will be missed. Observers have very few global reasons for their predictions, especially the negative ones. "He'll be able to pick `little` out. Surely he'd be able to read the first sentence so he'd just

take that right of out there. I think he would have a lot of trouble getting through the rest of the paragraph though so he probably wouldn't get any more right."

Both teachers and observers tend to have less elaborate thoughts about children facing paragraphs. Some teachers knew individual students would panic at the sight but for most children they assumed an attempt would be made to get some piece of the set of questions answered. Teachers' responses showed an understanding of individual students and in discussing items in this subtest they switched from focusing on the cognitive elements of the task and focused more on the psychological aspects of the child.

Conceptions of the Student, Conceptions of the Judges

Teachers did not describe the three subtests as classes of tasks that the student approaches. However, in their descriptions of the units and sources and, to some extent the student strategies, an underlying picture emerges. Teachers consider the first subtest to be test decoding and to be well within the boundaries of word meaning. In other words, the vocabulary test title does not refer to meaning but to reading level. The specifics necessary for decoding have either been taught or not taught. Observers focused less on the readability issue and more on the notions of meaning and word recognition and the probability of encountering the words.

For the second subtest, select the best word in brackets, teachers began to consider issues of meaning as well as decoding - but again did not overtly describe the parameter of the task. Observers stayed at the whole word level and emphasized the general knowledge portion of the task for students.

In the last subtest both teachers and observers became more vague in their reasoning. The teachers changed focus and concentrated on child strategies or the possibility of the child being psyched out by one paragraph rather than on an analysis of skills needed for the task. Perhaps the teachers are right and gearing up for paragraphs is more than half the battle.

Insert Figure 3 about here

When teachers are faced with the query concerning an item and a child's ability to respond to it, they seem to call on several stores of information. A diagram summarizes this in Figure 3. The teacher considers first the raw nature of the task, what things are needed to perform on the item. While this is not a task analysis per se, it is definitely slanted towards how things are taught. Then there seems to be a quick review of features of the item that would scare off the child or make it impossible for him or her to get it correct. This portion of the loop focuses on the skills required for categorizing the problem. The teacher then starts to focus on whether or not this particular child has had sufficient instruction to complete the item. This seems to be done by

bringing two or three segments of information together around the question of whether or not the child can do the task: (a) the location of the information in a text (level, chapter, page) or several texts; (b) the location of the target child with reference to that spot; or (c) the location of any child at or near that spot and then the location of the target child with respect to that child. Occasionally, reference is made to several texts that teach the same concept or element. Thus, the teachers figuratively roll out a scroll-like curriculum, point to the place of the information and search for the child either directly or in relationship to other children. The following two quotes from teachers seem to support this interpretation. "No. I don't think he would be familiar with that. We're not familiar with the aw or the suffixes or prefixes. We haven't gotten into that. Vocabulary - no. Tapes, reading - no, nothing, that I can think of." "She hasn't had a-w at all" - (Interviewer) "Let me just ask you a question. When you say that she hasn't had this, how do you remember?" (Teacher) "I know that a-w comes after where she is. Robin just learned that. That's how I know that. (I) So, sometimes you do it relative to other kids (T)...I have my mind on how I... ...Yeah on Level 9. And that in relation to what Cheryl and Robin are studying. I knew I just worked with a-w with Cheryl and Robin and that's why I could say like that." This latter portion of the diagram can be thought of as a curriculum structure node. Bringing the task and curriculum elements together permits problem solution.

When the task demands are not directly taught, teachers seemed to have less of a model of the task itself and were much less specific about why a child could or could not do the item. This was especially true for the paragraph section of the test. One notion might be that the teachers

were tired of doing the task. However, the teachers were asked to do 2 children and with the beginning part of the second child tended to return to the same level of detail.

Insert Figure 4 about here

Observers who acted as our informed novices were almost as accurate as the teachers but with much less articulated understanding as to why they made their assessments. Two of the observers seemed strongly influenced by the titles of the three subtests. Thus, Vocabulary was word knowledge and meaning. One observer saw the vocabulary subtest as decoding. Figure 4 diagrams their apparent searches to answer the question. There was a less careful consideration of the task demands and more arbitrary search for features that might produce child failure. The task is described mainly by repeating it rather than analyzing it. The curriculum search rarely was described except in the most global terms and there seemed to be little knowledge if any about what was presented where in texts, or where the children were located. One might think that this was simply an issue of exposure. However, observers collected curriculum location information, read all the curriculum texts and spent considerable time entering the words and their frequency of usage from the main curricula into the computer. They also coded what the children were doing - that is the nature of the task. Observers seemed to know less and to have a less distinct pattern of searching for the information that they do have, than did teachers.

Implications

The implications of this research are relevant for our understanding of what individuals with similar levels of performance can do with the information. Teachers who are collecting their knowledge in instructionally relevant setting are poised to use their information about students - for the teaching of students. Our observers, who had collected their information in instructional settings but not in the context of instructing, have the data (how kids will perform) but have little grasp of the whys or what to do about it. This raises two issues; one concerns the education of new teachers; the other the advance of our understanding of teacher cognitions.

Novice teachers might very well perform less proficiently in the overlap task than did the observers. Their skill at observing may be clouded by the sheer effort of survival the first few years. But, if we are to help them in their survival, it would seem wise to teach them to monitor student growth and exposure to curriculum content, to assess task demands, and to determine where information to meet those demands is located. Assuming that new teachers are unlikely to know their students in advance, a thorough knowledge of several interlocking curricula in advance would seem to be advisable.

If we review what is known about how novices and experts differ, the first and most powerful difference lies with how the task is conceived. Teachers tended to see each item as consisting of teachable elements which had or had not been taught and to merge that with knowledge about students. Three basic schemas were called up: one on task assessment, one on curriculum, and one on students. Novices saw the tasks as a

judgment of item difficulty based on familiarity of words - they rarely if ever used a curriculum schema and relied heavily on a type of child schema that was very global. Novices, driven by a goal to respond, developed no consistent plan of attack to the items but moved rapidly to a judgment call. The internal representation seemed to be "How hard would this be for me?" We can be fairly certain that the novices had the curricular declarative knowledge necessary for more elaborate representations and strategies for solutions but were unaware of the relevance. The task elicited a different schema for solution, one that was child and self focused. They had the declarative knowledge but used the 'wrong' procedural knowledge.

As part of the research about teachers' thoughts while teaching, this study increases our understanding of one small piece of teachers' thoughts: students' exposure to curriculum content. Many other pieces are needed before the picture emerges more clearly. Figures 1 and 2 map out some of the elements and relationships about which we need to learn.

Specifically we need to understand the nature of the operating plans that teachers carry with them into the lesson. The relationship between teachers' subject matter knowledge, classroom instruction and student conceptions of subject matter are also relevant for our understanding of the knowledge structures of expert teachers. By integrating several of these presumably complex elements of thought we can begin to work toward more complete and rigorous model of expertise in teaching.

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Table 1
Means, Standard Deviations, and Correlations
N = 105

	Overlap	Hits
Observers	54.38 (27.20)	59.98 (10.67)
Teacher	56.33 (23.01)	64.30 (11.90)
Actual % Correct	52.51 (21.35)	

	1	2	3	4	5
1. Teacher Overlap	X	.09	.67	.31	.23
2. Teacher Hits		X	.39	.11	.18
3. Actual Score			X	.39	.26
4. Novice Overlap				X	.31
5. Novice Hits					X

Table 2
Average Number of Lines of Protocol
and Ranges by Subtest

	Observer	Teacher
Vocabulary	27.33 *(20 - 39)*	32.14 *(30 - 53)*
Comprehension: Sentences	25.50 *(15 - 49)*	43.00 *(25 - 63)*
Comprehension: Passages	22.33 *(15 - 36)*	35.20 *(29 - 40)*

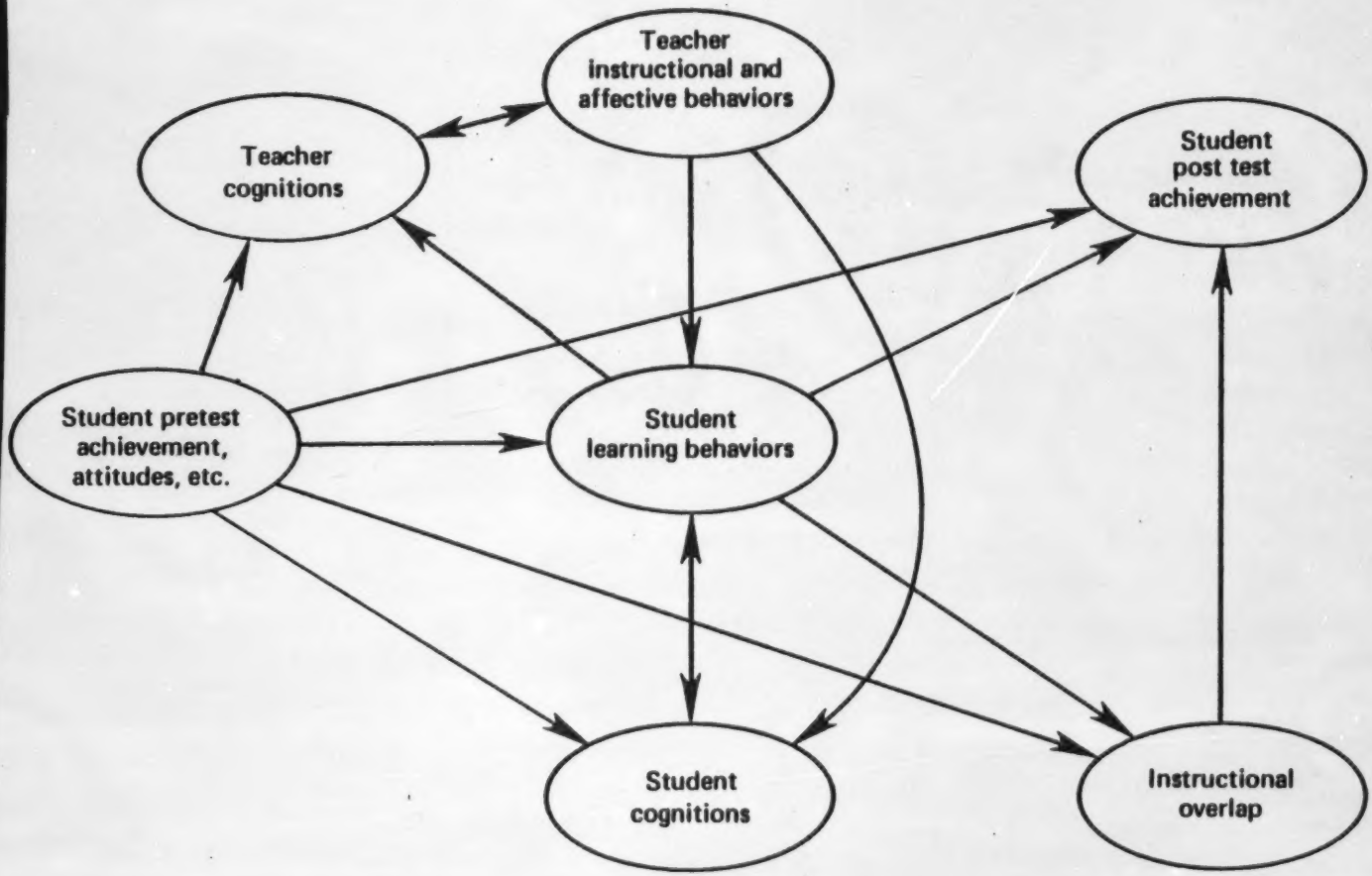

Figure 1. General model of instruction and cognition.

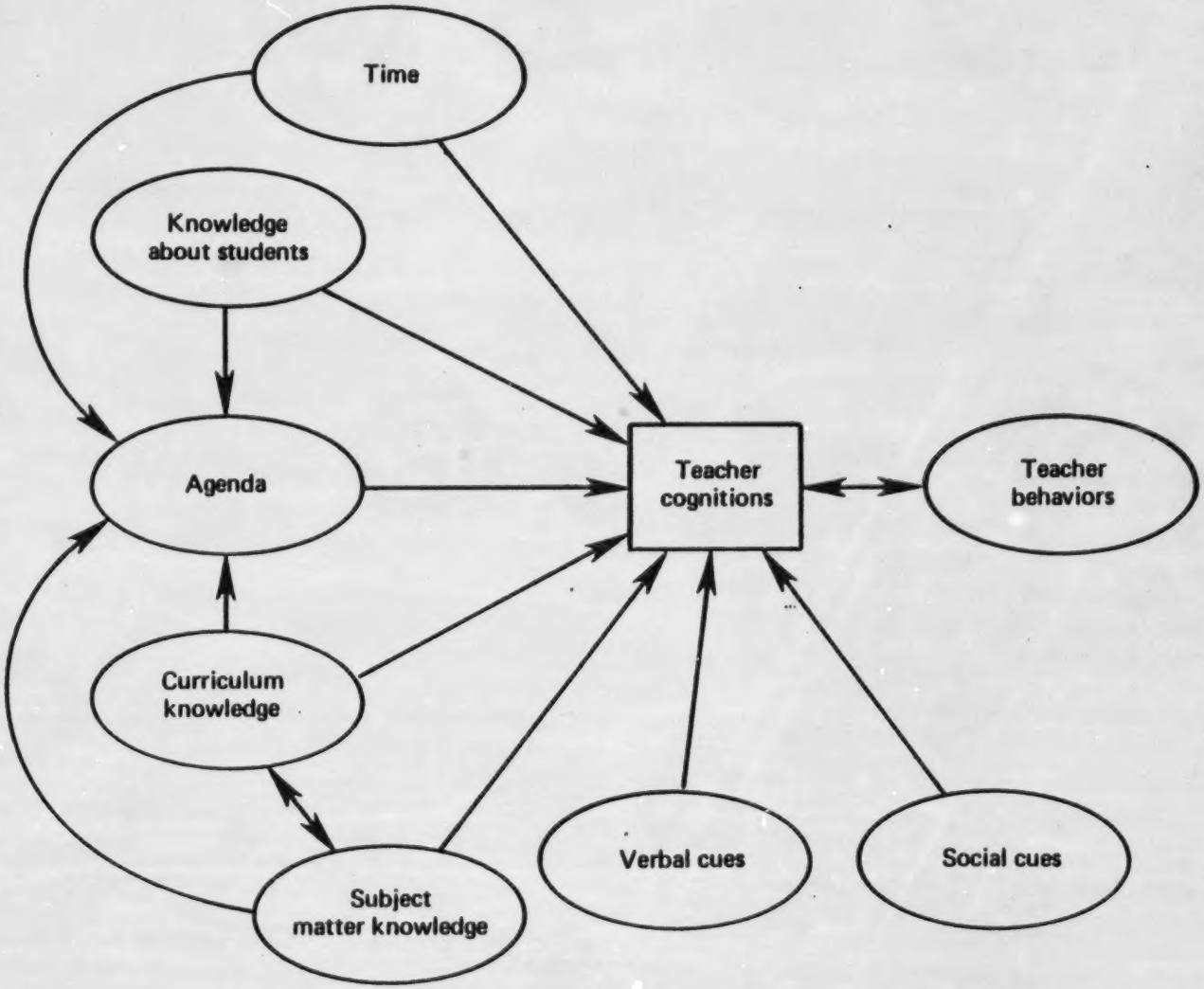

Figure 2. Relationship between available information, cognition and behaviors.

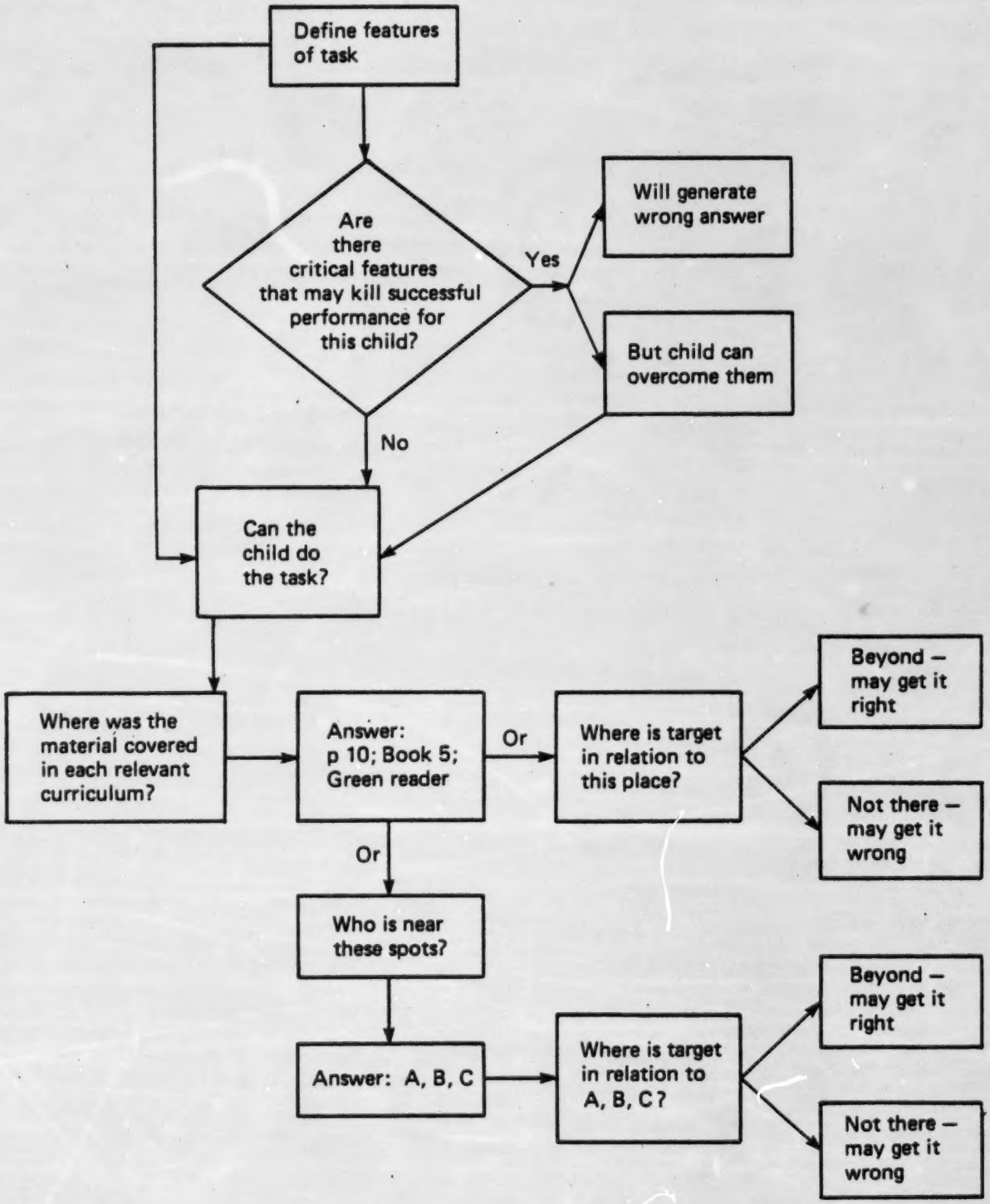
Define features of task
Are there critical features that may kill successful performance for this child?
Yes
Will generate wrong answer
But child can overcome them
No
Can the child do the task?
Where was the material covered in each relevant curriculum?
Answer: p 10; Book 5; Green reader
Or
Where is target in relation to this place?
Beyond – may get it right
Not there – may get it wrong
Or
Who is near these spots?
Answer: A, B, C
Where is target in relation to A, B, C?
Beyond – may get it right
Not there – may get it wrong

Figure 3. Diagram of teachers' sequence of thoughts for overlap task.

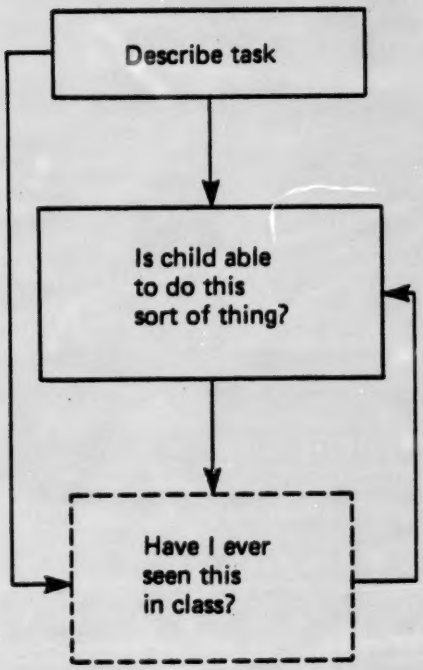

Figure 4. Diagram of observers' sequence of thoughts for overlap task.

Appendix

Directions

For the Overlap Estimate Task

We're trying to determine how closely this test measures what your students have been taught. To do this, we'd like you to estimate which items on the CTBS you have taught to each student. This is the level of the CTBS that (student's name) took. I'd like you to look at the items to determine if you think he was taught the information required to get each item correct. In considering each item, please take into account the way the item is presented as well as the content of the item.

Directions for Reading Vocabulary Subtest

In this subtest, I gave a definition of the word marked, and the student had to find the word from four alternatives. For example, the task for the first sample item, D-1, is to name a pet. The correct answer has been marked for you to make it easier for you to determine if (student's name) has been taught the meaning-word relationship, and I'd like you to circle the item number if you think (student's name) has been taught the information required to complete the item correctly. Now, when you reach an item that has been checked, please say what you're thinking, that is, try to verbalize your thought processes, your search strategies, or in

general how you know whether or not (student's name) was taught the information required to get that item correct. In other words, you don't have to tell me for each item, just for the ones that are checked.

Items for Reading Vocabulary Subtest

5	●	wet	10	0	fry
	0	dry		●	bake
	0	dirty		0	boil
	0	clean		0	birthday
15	0	saddle	20	0	big
	●	gallop		0	light
	0	slide		●	heavy
	0	walk		0	package
25	0	four	30	0	nice
	●	count		0	ugly
	0	spell		●	awful
	0	teach		0	arrive
33	0	load			
	0	want			
	0	hate			
	●	admire			

Directions for Reading
Comprehension: Sentences Subtest

Okay. Now, go to page 4. The Reading Comprehension Sentences subtest is on pages 4, 5 and 6. The student was supposed to read the sentence, and choose the word that makes the sentence correct. (Student's name) worked through this subtest by himself. Once again, please circle the item number if you think (student's name) was taught the information necessary to correctly respond to the item, and talk about the items we have checked.

Items for Reading
Comprehension: Sentences Subtest

2 It is nine { 0 hour ● o'clock / 0 time 0 children } in the morning.

6 Grandmother is coming to { 0 hill ● visit / 0 care 0 family } us.

8 Listen to that loud { ● music. 0 regular. / 0 plate. 0 smile.

11 People { O hop O dime / ● clap O hand } when they enjoy a show.

16 The dog { O went O jumped / O bark ● brought } the paper to Dad.

21 The { O buy O orbit / ● rent O November } must be paid today.

Directions for Reading
Comprehension: Passages Subtest

Okay, now. This is the Reading Comprehension: Passages subtest, and it's on pages 7, 8, and 9. The student was asked to read each passage, and then answer the questions that follow it. Circle the item number if you think (student's name) was taught the information necessary to correctly respond to each question, and again, we've marked the ones we want you to talk about.

Items for Reading
Comprehension: Passages Subtest

Silver was a little pony. One day he was running in the hills and caught his foot in some rocks. Soon a hungry wildcat came toward Silver. Silver began crying for his mother.

Silver's mother was a big, brave horse. She ran to help him. She kicked at the wilcat and made loud noises. Then the wildcat ran away. Some cowboys came to help the little pony.

6 What kind of horse was Silver's mother?

- O little
- ● brave
- O quiet
- O afraid

7 Which sentence is the best ending for the story?

- O The cowboys hid.
- O Silver's mother ran away.
- ● Silver was a lucky little pony.
- O The wildcat was not hungry.

8 Which name is best for this story?

- O "The Cowboys"
- O "Mother Wildcat"
- O "The Wildcat's Friend"
- ● "Silver and the Wildcat"

9 What happened first in the story?

- O The wildcat ran away.
- ● Silver got his foot caught.
- O Some cowboys came to help.
- O Silver's mother kicked at the wildcat.

Two spacemen were in a rocket. Outside, the astronauts could see the stars and the moon. In back of them was the earth. In front of them was the moon. The moon seemed to be growing larger and larger as the earth grew smaller.

16 What were the spacemen riding in?

- O a car
- O a train
- ● a rocket
- O an airplane

17 Where were the spacemen going?

- O to the rocket
- ● to the moon
- O to the earth
- O to the stars

18 What happened as the spacemen traveled?

- O The moon got shiny.
- O The moon got darker.
- ● The moon looked larger.
- O The moon looked smaller.